From Campus to Real-World Contexts: Transforming Higher Education with GamBLe EduCache

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Abstract

This paper presents GamBLe EduCache, an innovative educational initiative that integrates geocaching and gamification elements into university teaching. The project supports first-year students while promoting active learning and interdisciplinary engagement. Students analyze materials and processes at industrial and historical sites through cache-based activities, enhancing their digital competencies via a digital learning platform while supplementing traditional coursework with practical, location-based experiences. The project operates on two levels: providing structured learning opportunities for first-year students through pre-designed caches, and engaging advanced students in creating their own educational caches. The gamification approach incorporates competitive elements to motivate teamwork and active participation. Initial evaluation results show positive outcomes, with high rates of reported learning success and strong support for the gamification approach. Through partnerships with museums and archives, GamBLe EduCache creates a broader educational network that bridges academic theory with practical heritage work while making materials available as OER.

Keywords: Interdisciplinary; geocaching; experiential learning; digital competencies; collaboration; open educational resources (OER).

1. Engaging minds and shaping education: A collaborative approach to university challenges

The interdisciplinary project *GamBLe EduCache*, funded by the Ministry of Culture and Science in North Rhine-Westphalia, is an innovative educational initiative that enriches university teaching through integration of extracurricular learning spaces in the Rhine-Ruhr area. Developed through a collaboration between the TU Dortmund University, Ruhr-

University of Bochum, and the University of Duisburg-Essen, this edu-caching-based educational concept, that combines learning activities with geocaching, brings together diverse departments, including Mechanical Engineering, Architecture and Civil Engineering, Geography, History, and Technology Didactics to create an engaging learning environment that promotes early course material engagement and fosters relevant future skills. This interdisciplinary approach addresses several critical challenges in higher education, particularly the difficulties first-year students face during their transition from secondary education. In mandatory courses attended by hundreds of students each semester, traditional teaching methods often struggle to facilitate meaningful interaction and maintain student engagement throughout the term (Baumann, 2016). Many students postpone their learning efforts until shortly before examinations, leading to suboptimal outcomes and persistent knowledge gaps that may extend into advanced studies. Since the Bologna Process, self-study has become increasingly important, accounting for approximately two-thirds of the total workload in foundational subjects. A recent survey revealed that 70% of lecturers see a need to support students in their self-study efforts (Kleß, 2017), particularly during the critical initial phase of university studies. Thus, the project *GamBLe EduCache* implements a unique combination of playful and practical engagement with subject-related content, supplementing traditional coursework through interaction with physical spaces. The project incorporates gamification elements such as different levels and a points system, fostering motivation and strengthening teamwork skills as students compete in small groups to earn points through various activities what was analysed by Kettler & Kauffeld (2019) or Cózar-Gutiérrez & Sáez-López (2016). These topic-specific caches align with course curricula and offer additional examination points for achieving certain goals, creating tangible incentives for active participation. During the conceptualization of the caches, standardized templates were developed in advance to ensure the provision of accessible teaching materials and activities. Furthermore, the team-based participation model was designed to account for potential limitations faced by students with dissabilities, recognizing that not all tasks may be independently executable by every participant. Consequently, it suffices for selected team members to perform specific tasks while receiving support from their peers. Additionally, individual tasks can be omitted without compromising the acquisition of core learning content. Beyond first-year students, the project actively involves advanced students in designing learning processes, allowing them to create their own caches while developing key competencies in teamwork, target group analysis, media literacy, inclusion, and accessibility. Students analyze materials, technologies, and explore spatial, historical, and geographical processes on-site, creating direct connections between theoretical knowledge and real-world applications. This approach not only enhances practical relevance but also motivates continuous and reflective engagement with subject content. The project's digital infrastructure, built on the *Moodle* learning management system, allows for temporal independence and broader accessibility, with all materials available as *Open Educational Resources* (OER).

2. The didactic framework for engagement and collaboration

The central idea of our project lies in integrating students as active designers of and participants in their learning processes across two complementary levels: (1) We provide the caches to first-year students who are navigating their new learning environment with its various challenges. The transition from school to university often brings uncertainties and new demands. The caches offer a low-threshold opportunity to playfully engage with complex and unfamiliar topics while fostering a sense of self-efficacy. Students can learn at their own pace, gradually working through the content, which eases their transition to university and enhances their intrinsic motivation. Studies have shown that gamification positively impacts learners' intrinsic motivation and attitudes toward educational content. According to Zeybek and Saygı (2024), most studies report increased motivation and engagement among learners, primarily attributed to the playful elements of gamified learning environments. Furthermore, gamification promotes interaction and collaboration, as cooperative learning processes enhance participants' willingness to actively engage and work together. These cooperative elements are particularly valuable for first-year students, creating opportunities for social interaction and fostering initial peer connections and friendships. Through group activities and shared challenges, students connect with classmates, building a sense of community and belonging essential for their university experience. These early connections support both academic collaboration and provide a social foundation that helps students navigate their new environment more confidently. Consequently, our project emphasizes "friendly competition" (Cavus et al., 2023) as a key element to foster both motivation and social interaction among students. The points-based system and levels within the caches encourage students to challenge themselves and their peers in a supportive environment. This gamified learning approach not only motivates participants to engage with the content but also strengthens team dynamics and collaboration. Working in small groups, students combine their strengths, share ideas, and solve problems together, naturally building trust and camaraderie. The competitive aspect remains balanced, emphasizing shared success and learning rather than creating pressure. Moreover, we create an extrinsic incentive that can provide secondary motivation for students: We award points to cache completers that can be applied to their grade in the module's examination. Thus, they can slightly improve their achieved grade. This approach offers students an additional opportunity to engage more deeply with the course material, providing a tangible reward for their active participation and learning efforts beyond the traditional assessment methods. Through these interactive learning environments, students also develop digital competence, preparing them for the demands of higher education. Cache-based learning allows them to apply theoretical content practically while promoting independent learning and problem-solving skills. Additionally, the gamified structure breaks down complex topics into manageable steps, lowering the threshold for tackling challenging material.

(2) The second key aspect involves advanced students actively creating their own EduCaches. This process demands strategic planning, logical reasoning, and critical reflection while also fostering motivation and key skills in target group analysis and media competence. By independently creating EduCaches, the students deepen their subject knowledge in various fields and introduce creative approaches to teaching. Their engagement with digital platforms and tools enables them to create interactive formats and strategically use multimedia content. This peer-to-peer model encourages dynamic, practice-oriented exchange tailored to specific target groups, including fellow students and prospectively, pupils and school classes. Team collaboration strengthens social competencies like communication, conflict resolution, and cooperation. Students maintain an ongoing dialogue with lecturers and tutors, seeking guidance and feedback. This continuous dialogue deepens their understanding while refining methodological and analytical skills. By combining independent work, teamwork, and professional guidance, the project fosters a holistic learning process that builds knowledge while strengthening students' sense of responsibility and capacity for reflection. The iterative development process, where students test, evaluate, and refine existing EduCaches, ensures quality while increasing awareness of knowledge transfer complexities. This process emphasizes inclusion, accessibility, and sustainable design, with materials available as OER for broad, long-term access for reuse by other educators from diverse fields.

The particularly distinctive feature of the GamBLe EduCache project is its integration of real-world locations into university teaching. By conducting caches at industrial and historically significant sites within the Ruhr area, students have the unique opportunity to engage with authentic environments that are closely tied to the subject matter they are studying. This approach moves learning beyond abstract classroom concepts into real-world contexts, where students can directly experience and analyze materials, technologies, and processes in situ. This hands-on engagement bridges the gap between academic theory and practical application (Bouchrika, 2025). On-site learning sharpens observational and analytical skills while connecting theoretical knowledge to practical applications, which has a demonstrably positive effect on their learning process as Ohl & Neeb (2012) have proven. The physical connection to locations adds relevance and immediacy to learning, making it more engaging and memorable. Ciprina et al (2025) have shown that site-specific learning develops critical awareness of the surrounding environment, prompting reflection on broader societal and industrial issues like sustainable development, urban transformation, and historical significance. This immersive experience fosters curiosity and exploration, motivating active environmental interaction. Thematically, the project utilises different locations of the Ruhr's industrial heritage. One example illustrates the different perspectives of the disciplines involved: The examination of a former blast furnace allows e.g., geography to address questions about the choice of location and the necessary infrastructure, which was needed to produce iron. Additionally, students in the engineering field gain practical insights into the processes of metallurgy and manufacturing.

From the perspective of historical studies, sites such as former blast furnaces offer valuable opportunities to engage with the socio-economic and cultural dimensions of industrialization. The variety of locations ensures dynamic, multi-faceted learning that emphasizes interdisciplinary connections. Combined with gamification elements, the use of real-world locations creates an educational experience that is both academically enriching and deeply impactful, preparing students to approach future challenges with practical, reflective, and well-rounded perspectives. Moreover, the interdisciplinary collaboration creates synergies between different disciplines and universities. Overall, more than 1000 students benefit directly from this initiative as the learning game is embedded in 14 subjects. The close cooperation among various disciplines allows students to gain insights beyond the confines of their own fields. This initiative enables students to autonomously utilize learning materials from other disciplines, thereby fostering a deeper engagement with the respective non-university learning location and enhancing their understanding of its unique characteristics from different perspectives.

In the civil engineering curriculum, students explore a comprehensive material cycle to understand construction materials' life cycles. Engaging learning methods like quizzes, videos, and podcasts enhance their grasp of the content. Initially, they focus on material origins, such as blast furnaces, and learn fundamental production processes while examining structures that use these materials. As they advance, students create EduCaches in an elective course to investigate building damages and analyze real-life examples for repair concepts. They also develop various teaching materials for their peers. The curriculum addresses material recycling, promoting sustainable practices in civil engineering and efficient resource use. The following chapter will present the learning outcomes from the students' perspective.

3. Future perspectives and first brief insights into evaluation results

GamBLe EduCache offers promising potential for advancing modern teaching and learning formats. Given the ever-changing demands in higher education, developing innovative approaches that effectively combine digital and analog elements is crucial. Through continuous integration of technologies and interactive methods, teaching formats can be created that facilitate learning and foster creativity, problem-solving skills, and sustainable delivery of complex educational content. The experiences gained from this project can serve as a foundation for future initiatives to create dynamic and adaptable learning environments. Therefore, having a comprehensive evaluation concept is essential to measure the effectiveness and success of *GamBLe EduCache*. Evaluation serves not only to assess goal achievement but also to improve teaching and learning formats continuously. Student surveys are and will be conducted to gather feedback and share experiences to draw well-founded conclusions about the project's impact.

In the first pilot phase of the project in the summer semester of 2024, 98 architecture and civil engineering students completed the project in teams. After the exam, 84 students voluntarily

participated in the evaluation and shared their experiences and opinions. The evaluation questions were published in the digital course room and included various items based on a Likert scale. This scale allowed students to provide their assessments in a structured format, thereby yielding valuable insights into their perceptions of the course and the exam content. Participation in this evaluation not only offers a platform for feedback but also contributes to the continuous improvement of EduCaches. Figure 1 shows that most students experienced learning success and improved their knowledge. The interdisciplinary addition from other subject areas was also perceived positively. About 74% indicated that they found the non-subject-related content meaningful and helpful. For nearly 40%, the non-subject-related content sparked interest in the corresponding topic. Another brief insight into the survey results gives hope for the upcoming evaluation results from other departments, as 89% stated that they would recommend to other instructors to incorporate a gamification approach into their courses.
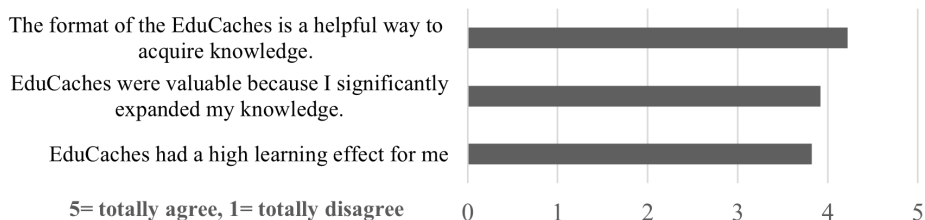

Figure 1. First evaluation results from the field of architecture and civil engineering.

To ensure the long-term success and continuous improvement of *GamBLe EduCache*, we are currently developing a comprehensive evaluation strategy that will assess the project's impact through both quantitative and qualitative analyses, enabling a deeper understanding of student engagement, learning outcomes, and the effectiveness of gamification elements. Our planned quantitative methods will include standardized surveys to measure intrinsic and extrinsic student motivation before, during, and after using the EduCaches, while we also intend to track usage statistics – such as activity levels, completed tasks, and earned points – via learning platform log data. This systematic data collection approach should allow us to identify behavioural patterns, such as engagement levels during competition phases or at specific game levels, potentially providing valuable insights into student participation and learning progress. Complementing these quantitative metrics, we are designing qualitative approaches to explore students' perceptions of the gamified learning environment through planned interviews and focus groups, where students will be encouraged to reflect on motivational factors, team dynamics, and the overall learning experience. We anticipate these insights will help determine which game elements are most effective in fostering engagement and collaboration. As part of our comprehensive approach, we are developing a framework for comparative analysis to examine the relationship between engagement levels and learning outcomes, which should provide a data-driven basis for optimizing the didactic design, while planned iterative feedback

loops will ensure the concept evolves based on empirical findings. Additionally, we are exploring the integration of OER to enhance accessibility and sustainability, with the goal of making materials widely available for future adaptation. By strategically integrating various evaluation methods, *GamBLe EduCache* seeks to create a solid framework for evaluating and enhancing its approach. This effort will ultimately support the development of innovative, data-driven teaching strategies in higher education. Currently, the creation of these evaluation tools and methodologies is in progress for implementation in future project phases.

Another long-term goal of this project is increasing accessibility to OER while promoting sustainable knowledge networking and collaboration with local partners. Through partnerships with museums and archives at industrial sites, we can tap into existing historical collections and expertise while making these resources more widely accessible. Given that museums have already established successful gamification practices in their educational programs (Holmes, 2020, p. 106), future collaborations will focus on combining and enhancing these existing approaches. Rather than treating heritage interpretation as a mere transfer of knowledge, this approach recognizes cultural legacy as an "open, subjective and ever-changing reflexive exercise" that engages with questions of "identity, inheritance, narrativity and belonging" (Marques et al., 2023). OER provides valuable resources for students and lecturers by freely making high-quality educational content available. Creating a network for disseminating these resources can help break down barriers while improving access to education for all. By actively involving museum curators and archivists, we enrich the cross-disciplinary networking experience by opening up new perspectives and connecting academic theory with practical heritage work. This active questioning of traditional frameworks allows for more dynamic and interpretative approaches to cultural heritage. Gotrian (2024) proves that digital media and collaborative tools enable us to bridge the traditional divide between popular and academic historical narratives, creating more inclusive and diverse approaches to historical interpretation. For reuse, the created content will be uploaded to ORCA and can be used by other lecturers individually without the geocaching component or as a complete concept. The modular structure not only allows it to be tailored for use across multiple disciplines but also enables seamless integration of museum and archive resources into various educational contexts, supporting a reflexive dialogue with cultural heritage rather than one-directional knowledge transfer. Overall, the project aims to address current challenges in higher education and make a long-term contribution to transforming the education sector.

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